FIG. 1

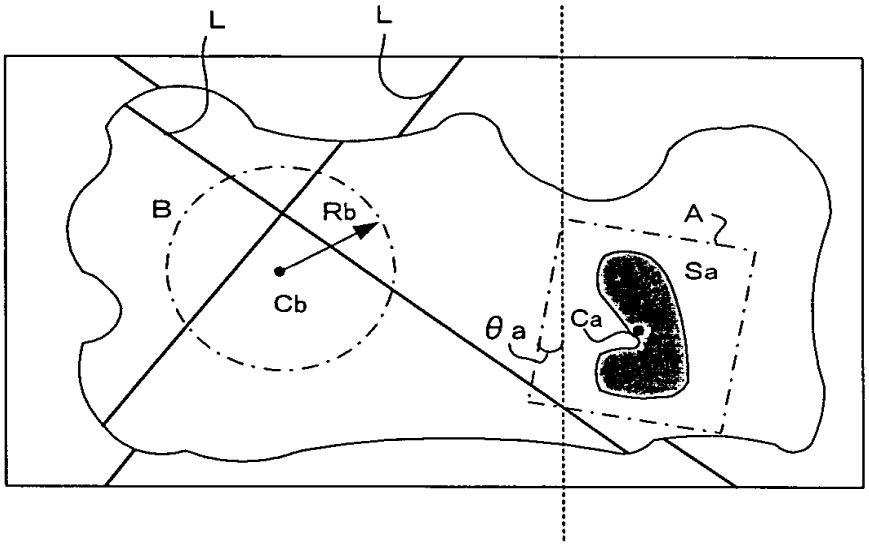


FIG. 2

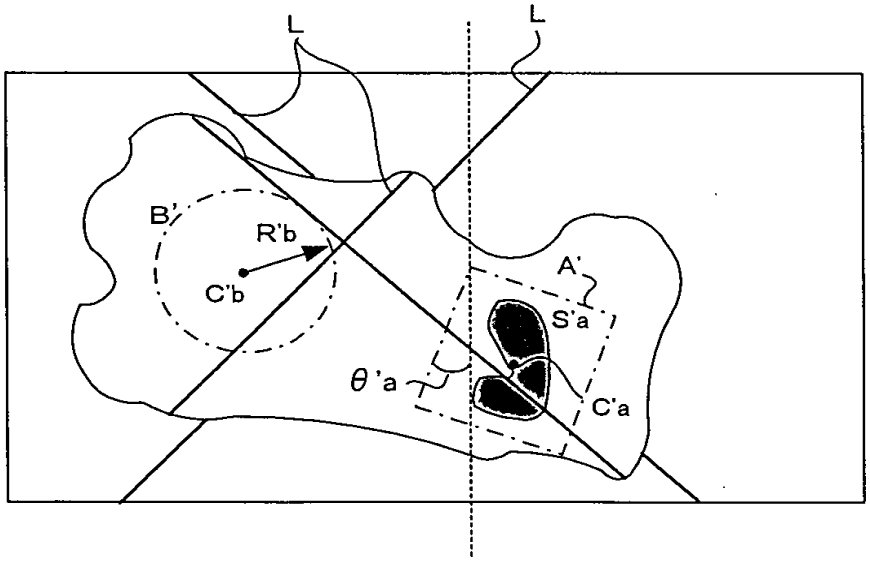


FIG. 3

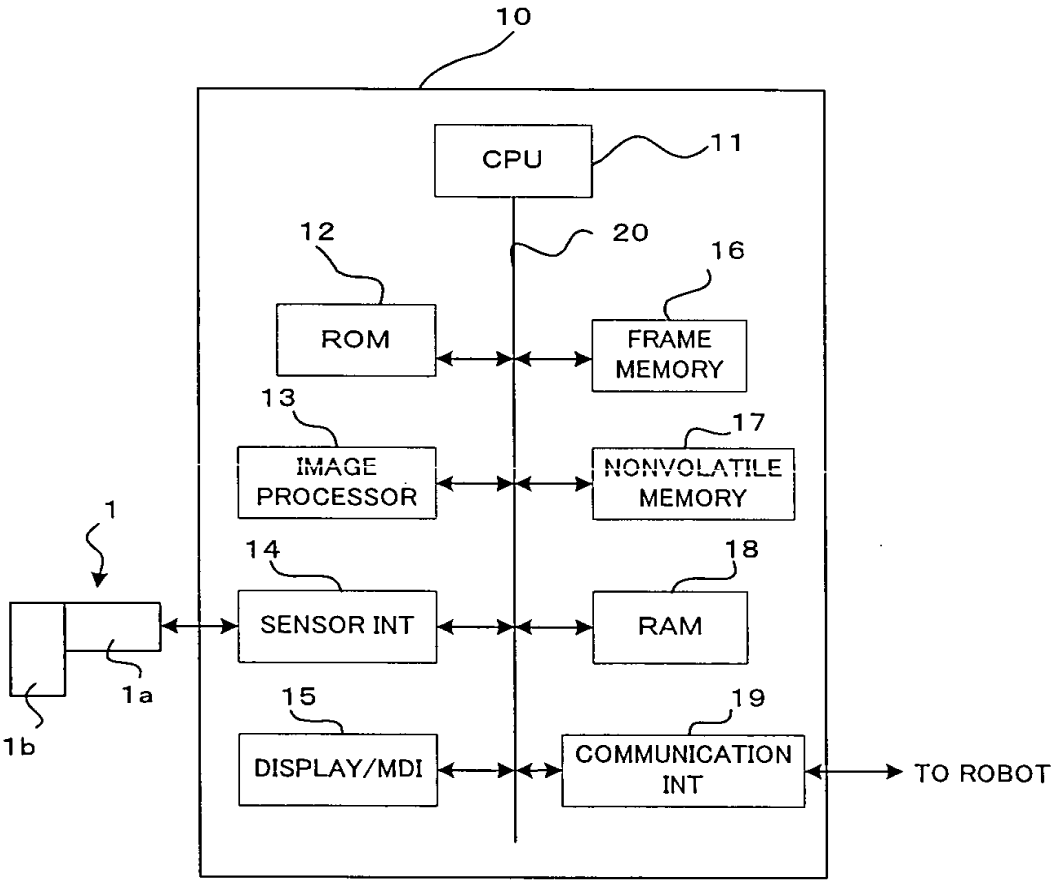

10
CPU
11
12
20
16
ROM
FRAME MEMORY
13
17
IMAGE PROCESSOR
NONVOLATILE MEMORY
1
14
18
SENSOR INT
RAM
1a
1b
15
19
DISPLAY/MDI
COMMUNICATION INT
TO ROBOT

FIG. 4

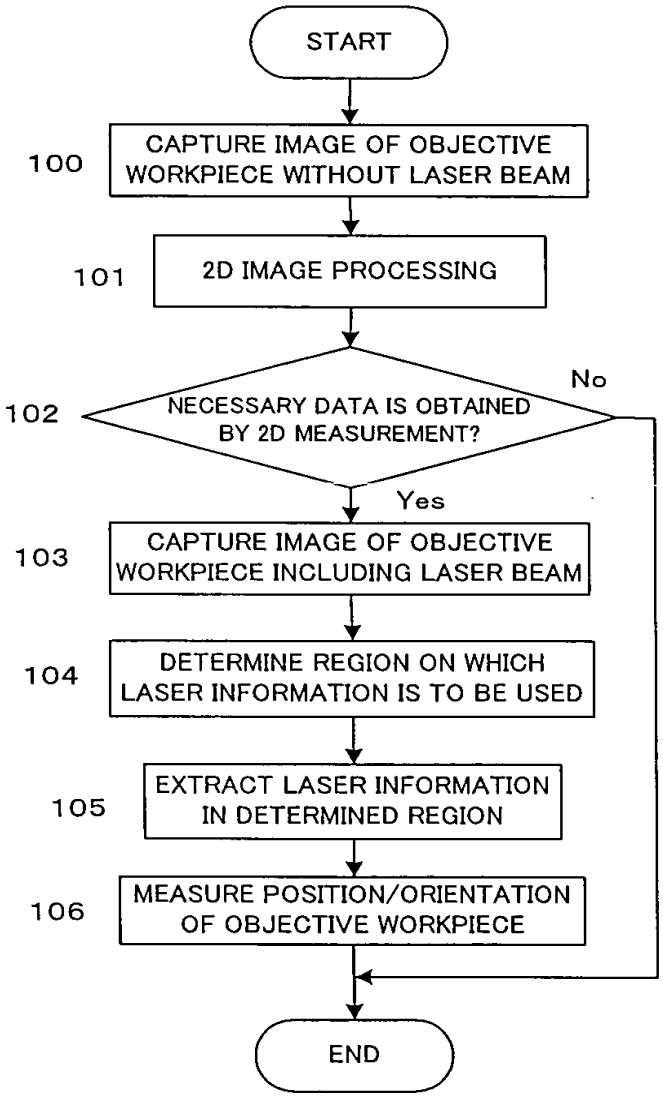

START
100
CAPTURE IMAGE OF OBJECTIVE WORKPIECE WITHOUT LASER BEAM
101
2D IMAGE PROCESSING
102
NECESSARY DATA IS OBTAINED BY 2D MEASUREMENT?
No
Yes
103
CAPTURE IMAGE OF OBJECTIVE WORKPIECE INCLUDING LASER BEAM
104
DETERMINE REGION ON WHICH LASER INFORMATION IS TO BE USED
105
EXTRACT LASER INFORMATION IN DETERMINED REGION
106
MEASURE POSITION/ORIENTATION OF OBJECTIVE WORKPIECE
END

FIG. 5

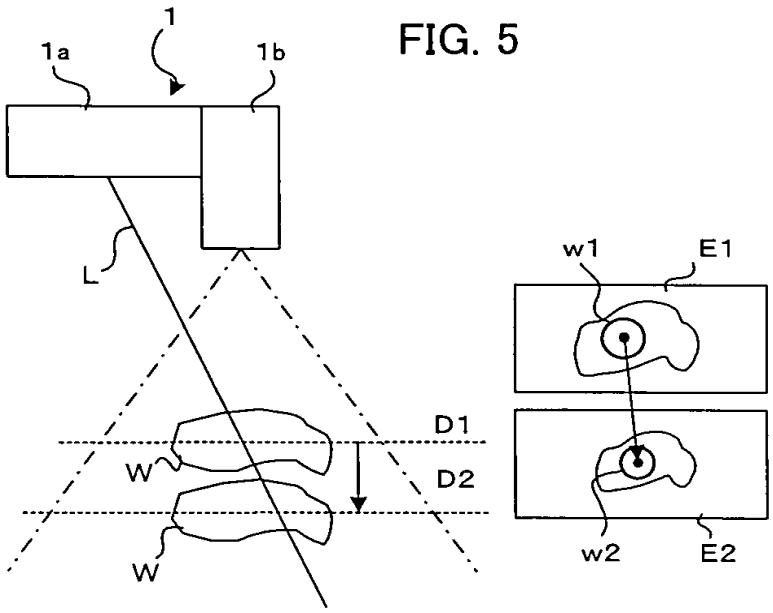

1
1a
1b
L
w1
E1
D1
W
D2
W
w2
E2

FIG. 6

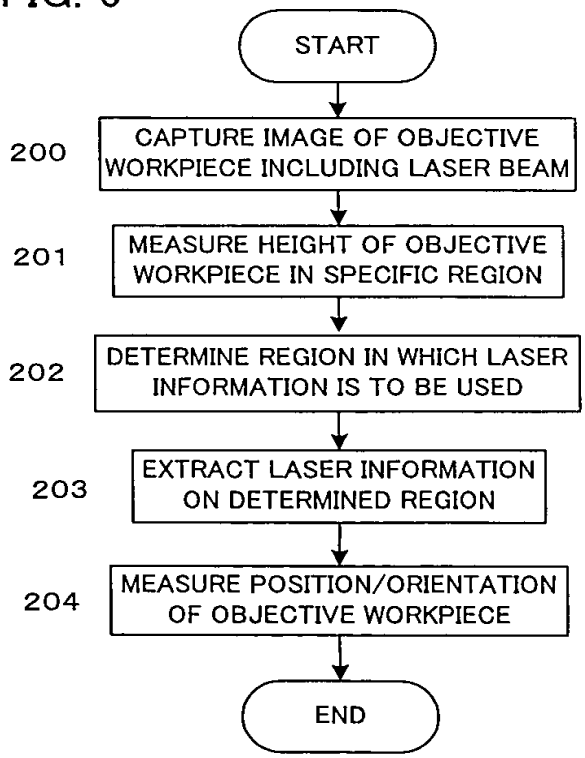

START
200
CAPTURE IMAGE OF OBJECTIVE WORKPIECE INCLUDING LASER BEAM
201
MEASURE HEIGHT OF OBJECTIVE WORKPIECE IN SPECIFIC REGION
202
DETERMINE REGION IN WHICH LASER INFORMATION IS TO BE USED
203
EXTRACT LASER INFORMATION ON DETERMINED REGION
204
MEASURE POSITION/ORIENTATION OF OBJECTIVE WORKPIECE
END

FIG.7a

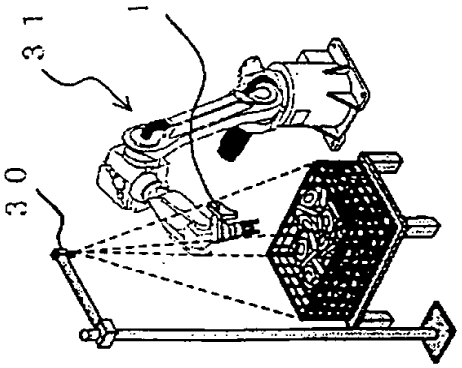


FIG.7a'

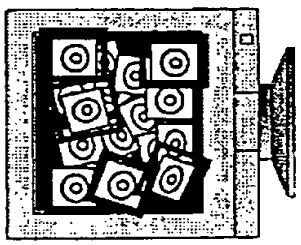


FIG.7b

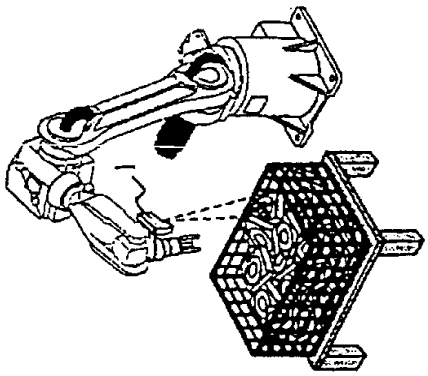


FIG.7b'

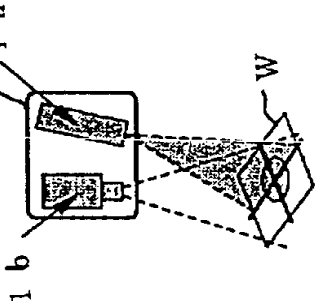


FIG.7c

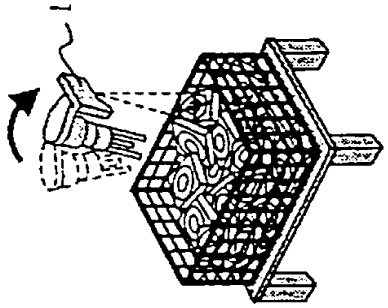


FIG.7c'

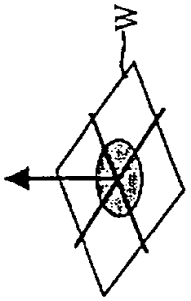
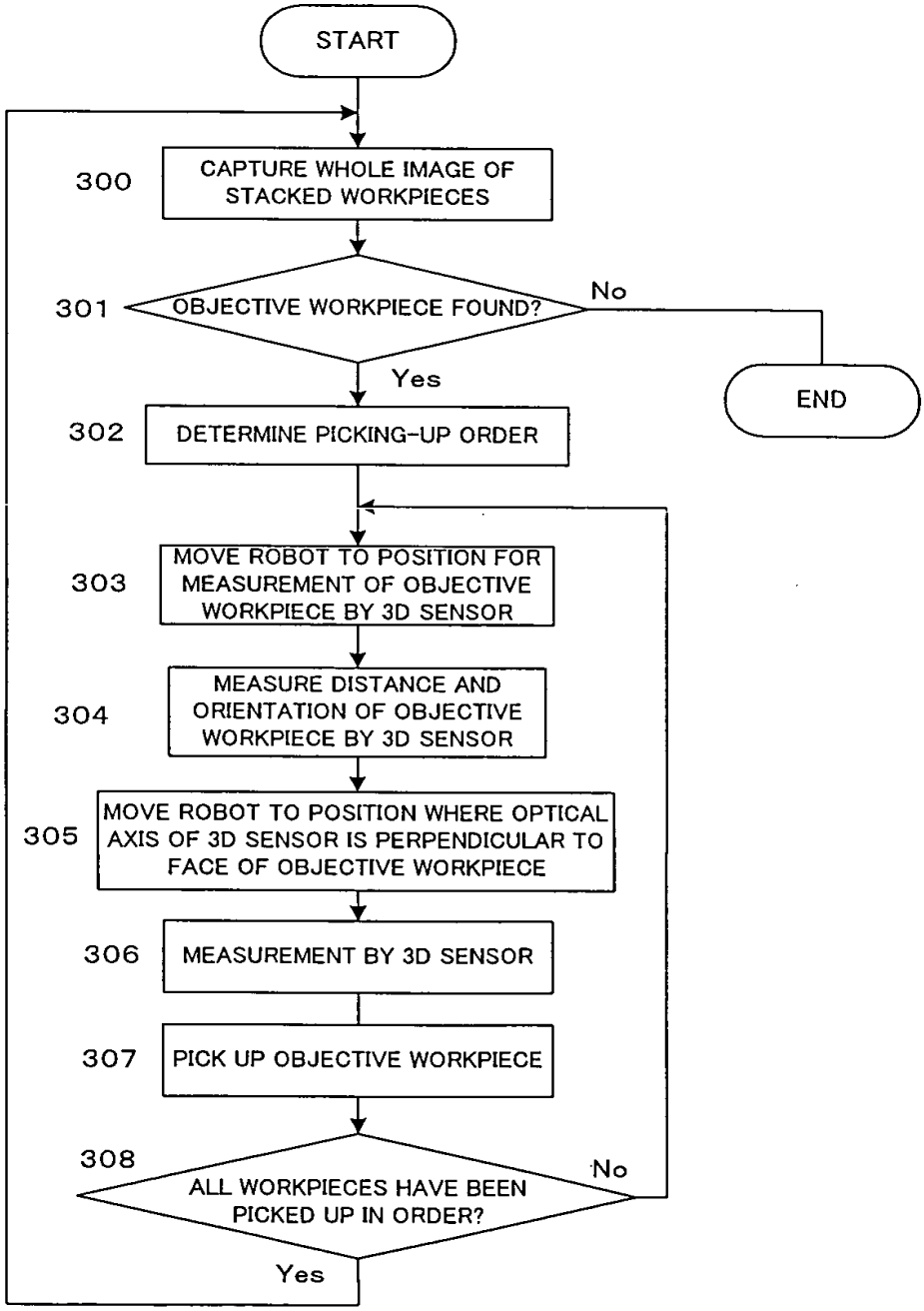


FIG. 8


START
300
CAPTURE WHOLE IMAGE OF STACKED WORKPIECES
301
OBJECTIVE WORKPIECE FOUND?
No
END
Yes
302
DETERMINE PICKING-UP ORDER
303
MOVE ROBOT TO POSITION FOR MEASUREMENT OF OBJECTIVE WORKPIECE BY 3D SENSOR
304
MEASURE DISTANCE AND ORIENTATION OF OBJECTIVE WORKPIECE BY 3D SENSOR
305
MOVE ROBOT TO POSITION WHERE OPTICAL AXIS OF 3D SENSOR IS PERPENDICULAR TO FACE OF OBJECTIVE WORKPIECE
306
MEASUREMENT BY 3D SENSOR
307
PICK UP OBJECTIVE WORKPIECE
308
ALL WORKPIECES HAVE BEEN PICKED UP IN ORDER?
No
Yes